EMFAC Modeling Change Technical Memo

SUBJECT: DETERMINATION OF STATEWIDE PERCENT OF HEAVY-HEAVY DUTY DIESEL TRUCK (HHDDT) VMT BY COUNTY

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Background

Currently, the on-road emissions inventory model, EMFAC2002, geographically allocates daily vehicle miles of travel (VMT) according to where those vehicles accumulating the mileage are registered. While this may be appropriate for passenger cars and lighter trucks, heavier trucks are known to spend a disproportionate percentage of their time either picking up or delivering goods outside of their base areas of operation.

The Air Resources Board (ARB) is now proposing to use the Motor Vehicle Stock, Travel and Fuels Forecast Report (MVSTAFF) published by CALTRANS to allocate heavy heavy duty diesel truck (HHDDT) VMT. Staff believes this will provide a more accurate alternative for spatially allocating the VMT of heavy-heavy duty diesel trucks.

In exploring this approach, staff analyzed over 8,000 surveys of truck travel collected by CALTRANS during which respondents provided information regarding both the origin and destination of each trip. Geographic Information System (GIS) route mapping tools were then used to infer the routes driven and ultimately, the relative amount of HHDDT travel accumulated in each of the State's fifty-eight counties. The route mapping algorithms were validated through a comparative analysis to actual routes driven as recorded by global positioning systems (GPS).

Staff then compared the county specific VMT distributions as suggested by the survey results to EMFAC2002 and MVSTAFF. The results showed the highest correlation between the survey data and MVSTAFF estimates as opposed to EMFAC2002. This suggests that MVSTAFF be used to redistribute the HHDDT VMT in EMFAC. The staff's analysis of the available data sources is included in the appendices.

The proposed redistribution would result in little overall change in emissions for the State as a whole. However, some sub-areas would be severely impacted. Table 1 presents a summary of the results in 2000 and 2010 for oxides of nitrogen (NOx) and particulate matter (PM). As shown in Table 1, there are significant increases in net emissions for the Mojave Desert, San Joaquin Valley and Salton Sea Air Basins, and significant decreases in the South Coas, San Diego, and San Francisco Bay Area Air Basins.

Table 1 – Summary of Net Changes in Emissions Due to the Redistribution of Heavy-Heavy Duty Truck Vehicle Miles Traveled for Year 2000 and 2010

Air Basin	Net Change in Emissions (tons/day)*			
	NOx		PM	
	2000	2010	2000	2010
Great Basin Valley	1.86	1.72	0.04	0.05
Lake County	-0.36	-0.19	-0.01	0.00
Lake Tahoe	-0.03	-0.01	0.00	0.00
Mojave Desert	81.50	64.24	1.45	1.53
Mountain Counties	2.52	2.22	0.09	0.08
North Central Coast	-4.55	-3.50	-0.11	-0.08
North Coast	-1.71	-0.54	-0.04	0.00
Northeast Plateau	5.15	2.41	0.14	0.08
Sacramento Valley	1.33	6.59	0.11	0.21
Salton Sea	25.67	15.81	0.50	0.29
San Diego County	-21.40	-16.49	-0.58	-0.38
San Francisco Bay Area	-44.81	-28.39	-1.09	-0.61
San Joaquin Valley	60.10	42.90	1.61	0.96
South Central Coast	-7.63	-5.32	-0.18	-0.11
South Coast	-85.38	-57.52	-1.85	-1.08
Total	**12.29**	**23.94**	**0.06**	**0.95**

*Net changes include redistribution of VMT in all other vehicle classes and associated emission impacts.

The estimate of the vehicle miles of travel (VMT) used in the EMFAC model are provided to the ARB by various transportation agencies throughout the State. These Councils of Government (COGs) and Metropolitan Planning Organizations (MPOs) rely upon travel demand models to generate the estimates. Most of the agencies submitting such estimates to the ARB do so as a single assumption of daily travel, where the relative contribution of cars and trucks to the overall total is indistinguishable. Under current practices, ARB staff estimates regional truck travel as the product of population and mileage accrual rates (miles per year traveled by age of vehicle). Once derived, this total is subtracted from the overall estimate and the balance of the VMT is attributed to the other vehicle classes in proportion to their population and mileage accrual. The question of attribution of travel on the basis of registration is what is being investigated in this analysis.

Analysis

The MVSTAFF is primarily intended for “short and long range statewide transportation planning, traffic forecasting and projections of revenues from excise taxes on fuel.” The report relies on estimates of economic trends to predict vehicle registration, miles of travel, fuel consumption, and fuel economy on a statewide basis. Table 2 below presents a comparison of the VMT of HHDDTs as reported by EMFAC (version 2.2) and MVSTAFF for calendar year

2000. Although the statewide totals are in reasonable agreement, the estimates vary considerably by county.

In order to determine which geographic distribution of VMT is most reasonable, staff analyzed the California Heavy Duty Truck Survey conducted by CALTRANS in 1999. In this study, 8,287 interviews were conducted at 50 sites throughout the state including weight stations, agricultural inspection stations, and roadside rest areas. Among the questions asked was where the truck began its trip, and where its destination was located. A complete report of the study can be found in the CALTRANS publication "Final Report 1999 Heavy-Duty Truck Travel Forecasting and Analysis" prepared by Strategic Consulting & Research, Inc.

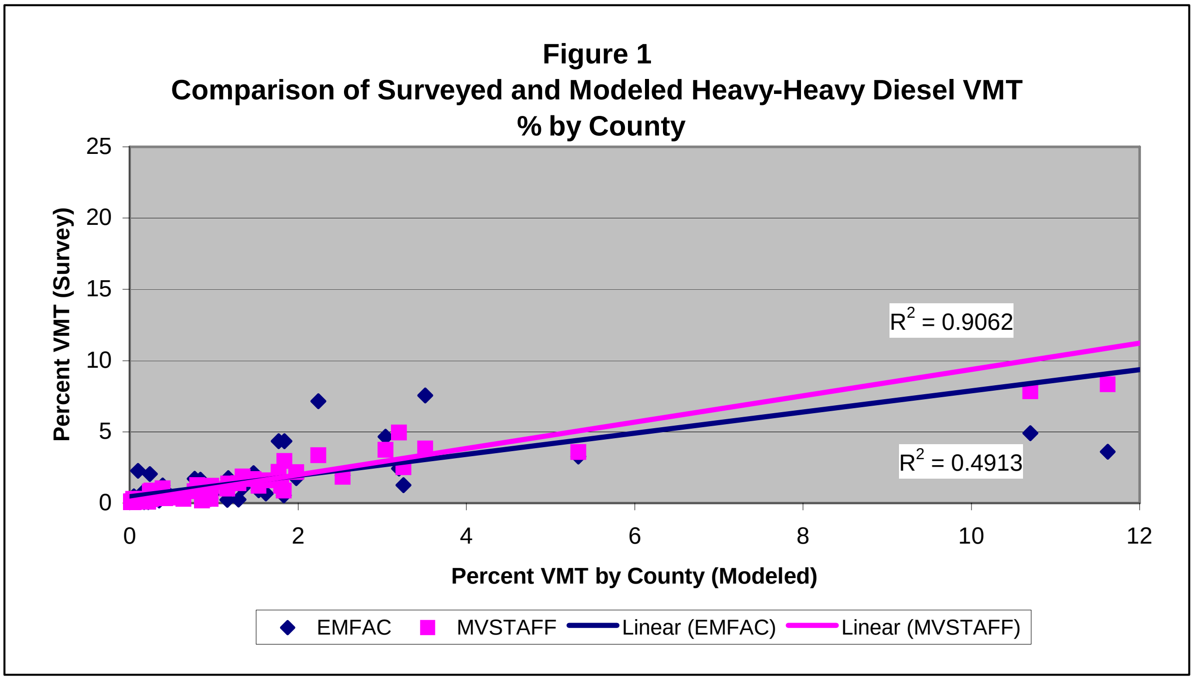
After intensive review, ARB staff used the information from the remaining 8,100 origin and destination (O-D) results, as well as the location of the interview, to infer the routes driven by each truck. Individual records were omitted mainly as a result of the inability to determine a logical route between origin and destination. Arc View 3.2 (a geographic information system software package) was used to systematically process the remaining O-D pair data, estimate each truck's mileage, and determine their VMT by county.

The county specific VMT estimates resulting from the analysis of the CALTRANS survey data was compared to those of MVSTAFF and EMFAC2002 to determine which model best approximated the empirically derived distribution. The results of this comparison yielded correlation coefficients (R^2) of 0.91 for MVSTAFF compared to 0.49 for EMFAC2002 (See Figure 1 below). In light of these results, staff recommends that EMFAC be modified to reflect the MFSTAFF VMT distribution for HHDDTs.

Table 2 – Heavy-Heavy Duty Diesel Truck Miles Traveled by County (Year 2000 – VMT/1000)

County	EMFAC	MVSTAFF
Alameda	1,134	836
Alpine	1	4
Amador	33	23
Butte	124	71
Calaveras	26	16
Colusa	57	184
Contra Costa	476	376
Del Norte	14	16
El Dorado	70	53
Fresno	855	799
Glenn	35	120
Humboldt	141	87
Imperial	274	272
Inyo	20	63
Kern	874	1,860
Kings	131	197
Lake	25	22
Lassen	23	65
Los Angeles	5,051	3,451
Madera	137	272
Marin	76	74
Mariposa	8	6
Mendocino	100	65
Merced	359	562
Modoc	13	24
Mono	17	37
Monterey	408	306
Napa	85	66
Nevada	44	123

County	EMFAC	MVSTAFF
Orange	1,392	750
Placer	149	268
Plumas	48	26
Riverside	1,157	1,751
Sacramento	967	662
San Benito	69	65
San Bernardino	1,218	2,605
San Diego	1,693	853
San Francisco	569	53
San Joaquin	688	1,103
San Luis Obispo	154	197
San Mateo	342	180
Santa Barbara	203	227
Santa Clara	972	492
Santa Cruz	156	44
Shasta	145	353
Sierra	4	15
Siskiyou	48	308
Solano	248	417
Sonoma	380	188
Stanislaus	515	409
Sutter	72	40
Tehama	51	227
Trinity	10	23
Tulare	458	485
Tuolumne	33	25
Ventura	287	215
Yolo	453	280
Yuba	53	31
Statewide	23,145	22,338



Validation of Methodology

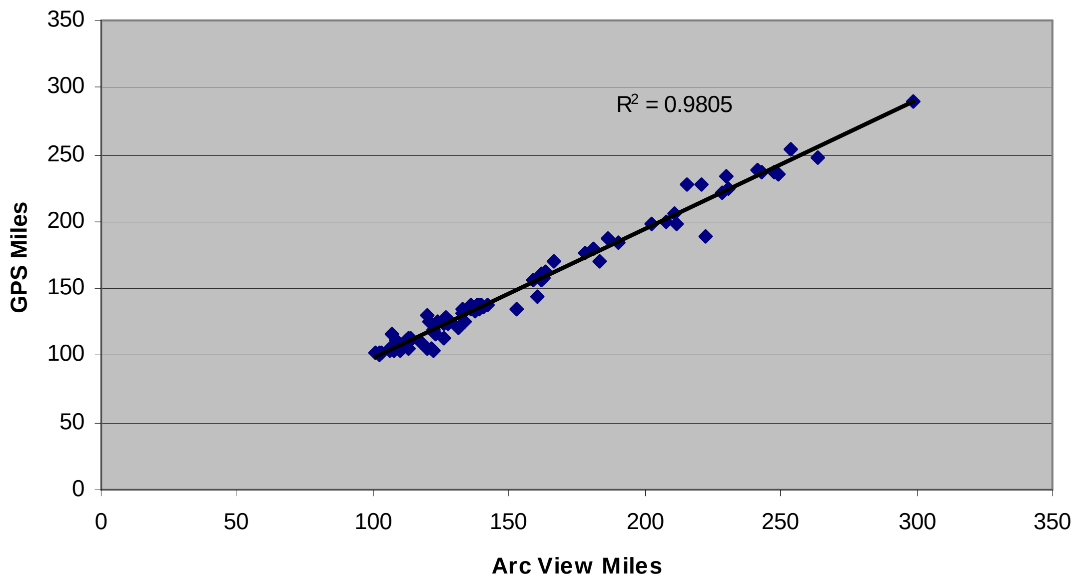
In order to validate the accuracy of the Arc View routing methodology, a subset of travel data collected from trucks instrumented with global positioning systems (GPS) were analyzed and compared. Under contract to the ARB, Batelle instrumented 149 heavy-duty trucks and collected detailed activity information. A complete description of this study can be found in the ARB report entitled "Heavy Duty Truck Activity Data," dated March 31, 1999.

Although the entire route was known for these instrumented trucks, staff used only the origin and destination information to determine if the methodology using Arc View would reasonably reproduce their activity. The results of this analysis are shown in Figure 2 below yielding a correlation coefficient of 0.98.

Model Modification

It is recommended that the base population data in EMFAC be modified to better reflect the travel of HHDDTs as opposed to the distribution by registration. This would be accomplished by scaling the regional population estimates to conform with the CALTRANS MVSTAFF travel estimates.

Figure 2
Correlation of Network Routing With GPS Database



In determining how best to backcast HHDDT activity from the adjusted baseline, staff analyzed historic MVSTAFF data to determine whether the distribution of VMT is stable over time. Nine geographic areas comprising over 50% of the total HHDDT travel were analyzed over a fifteen-year period. The results are displayed in Table 3.

Table 3 –% of HHDDT VMT by Geographic Area and Calendar Year (CALTRANS Motor Vehicle Stock, Travel and Fuel Forecast)

	1986	1991	1996	2001
Los Angeles	21.00%	18.21%	18.45%	16.70%
San Bernardino	9.50%	10.39%	9.79%	10.86%
Riverside	6.14%	8.35%	8.01%	8.02%
Orange	5.51%	5.13%	5.18%	4.90%
Kern	6.02%	6.26%	6.32%	7.35%
San Diego	4.93%	5.21%	5.55%	5.50%
San Joaquin	2.46%	3.18%	3.82%	4.28%
San Francisco	0.50%	0.39%	0.35%	0.25%

Given the general stability of the estimates over time and the fact that future VMT is dictated by Councils of Governments and Metropolitan Planning Agencies, it is suggested that EMFAC's internal growth and attrition algorithms be applied to an adjusted baseline using the historic MVSTAFF trend data.

Emissions Impact

Adjusting the model as suggested would result in little overall change in emissions on a statewide basis as MVSTAFF is in reasonable agreement with EMFAC's estimate of statewide HHDDT VMT (see Table 2). However regional inventories would be expected to increase or decrease in proportion to the change in activity, and in some instances these increases or decreases would be dramatic.

Assuming the overall estimates of VMT submitted by the COGs and MPOs are accurate, an increase in HHDDT VMT would result in a decrease in the VMT of other vehicle classes and vice versa, in order to retain the overall total within a geographic area. For purposes of this analysis, the term "Other" vehicle classes refers to all classes of vehicles modeled by EMFAC, including passenger cars, light-trucks, medium duty vehicles, etc., with the exception of HHDDTs. Because HHDDTs are major contributors of oxides of nitrogen (NOx) and particulate matter (PM) compared to the other vehicle classes, the area specific inventories would be most dramatically impacted by changes to this vehicle class (See Tables 4 through 7 below).

Table 4 – Baseline and Adjusted VMT for HHDDTs (Year 2000) (EMFAC2002 v2.2)

Air Basin	Baseline		Adjusted		% Change From Baseline
	VMT	% of Total State VMT	VMT	% of Total State VMT	
Great Basin Valley	38,000	0.16%	129,612	0.56%	241%
Lake County	25,000	0.11%	9,258	0.04%	-63%
Lake Tahoe	17,000	0.07%	16,202	0.07%	-5%
Moutain Counties	282,000	1.22%	411,981	1.78%	46%
North Central Coast	633,000	2.73%	409,667	1.77%	-35%
North Coast	403,000	1.74%	321,716	1.39%	-20%
North East Plateau	84,000	0.36%	337,917	1.46%	302%
Sacramento Valley	2,172,000	9.38%	2,214,977	9.57%	2%
San Diego	1,693,000	7.31%	624,915	2.70%	-63%
San Francisco	4,045,000	17.48%	1,809,939	7.82%	-55%
San Joaquin	3,969,000	17.15%	6,938,871	29.98%	75%
South Central Coast	644,000	2.78%	298,571	1.29%	-54%
South Coast	8,442,000	36.47%	4,654,460	20.11%	-45%
Salton Sea	398,000	1.72%	1,451,192	6.27%	265%
Mojave Desert	300,000	1.30%	3,515,726	15.19%	1072%
Total	**23145000**	**99.98%**	**23145004**	**100.00%**	**0.0%**

Table 5 – Impact of Proposed Changes on NOx (Year 2000 – Tons per Day)

	Baseline			Adjusted		
Air Basin	**HHDDV**	**Other**	**Total**	**HHDDV**	**Other**	**Total**
Great Basin Valleys	0.87	2.34	3.21	2.96	2.11	5.07
Lake County	0.63	3.61	4.24	0.24	3.65	3.89
Lake Tahoe	0.35	2.21	2.56	0.32	2.21	2.53
Mojave Desert	7.97	37.83	45.8	94.03	33.27	127.3
Mountain Counties	6.64	20.64	27.28	9.39	20.41	29.8
North Central Coast	13.96	35.13	49.09	8.93	35.61	44.54
North Coast	9.37	20.45	29.82	7.50	20.62	28.12
Northeast Plateau	1.99	5.50	7.49	7.75	4.89	12.64
Sacramento Valley	46.60	90.71	137.31	48.02	90.62	138.64
Salton Sea	8.99	17.22	26.21	36.19	15.69	51.88
San Diego County	36.40	109.12	145.52	13.43	110.70	124.13
San Francisco Bay Area	87.51	251.95	339.46	39.00	255.64	294.64
San Joaquin Valley	85.39	138.49	223.88	150.79	133.19	283.98
South Central Coast	15.47	53.22	68.69	7.24	53.83	61.07
South Coast	204.50	482.21	686.71	113.35	487.98	601.33
Total	**526.64**	**1270.63**	**1797.27**	**539.14**	**1270.42**	**1809.56**

Table 6 – Impact of Proposed Changes on PM (Year 2000 – Tons per Day)

	Baseline			Adjusted		
Air Basin	**HHDDV**	**Other**	**Total**	**HHDDV**	**Other**	**Total**
Great Basin Valleys	0.02	0.05	0.07	0.06	0.05	0.11
Lake County	0.02	0.07	0.09	0.01	0.07	0.08
Lake Tahoe	0.01	0.05	0.06	0.01	0.05	0.06
Mojave Desert	0.16	1.03	1.19	1.74	0.90	2.64
Mountain Counties	0.20	0.50	0.70	0.30	0.50	0.8
North Central Coast	0.36	0.89	1.25	0.24	0.90	1.14
North Coast	0.27	0.45	0.72	0.23	0.45	0.68
Northeast Plateau	0.06	0.11	0.17	0.21	0.10	0.31
Sacramento Valley	1.24	2.50	3.74	1.35	2.50	3.85
Salton Sea	0.26	0.51	0.77	0.81	0.46	1.27
San Diego County	1.00	3.26	4.26	0.37	3.31	3.68
San Francisco Bay Area	2.19	7.19	9.38	0.99	7.29	8.28
San Joaquin Valley	2.24	3.88	6.12	3.99	3.74	7.73
South Central Coast	0.37	1.31	1.68	0.17	1.32	1.49
South Coast	4.45	13.62	18.07	2.44	13.78	16.22
Total	**12.85**	**35.42**	**48.27**	**12.92**	**35.42**	**48.34**

NOx: Oxides of Nitrogen, **Other:** All other vehicle classes, i.e. passenger car, light-truck etc.,
PM: Particulate Matter 10 microns in diameter or less. Includes exhaust, tire and brake-wear.

Table 7 – Impact of Proposed Changes on ROG (Year 2000 – Tons per Day)

	Baseline			Adjusted		
Air Basin	**HHDDV**	**Other**	**Total**	**HHDDV**	**Other**	**Total**
Great Basin Valleys	0.05	1.54	1.59	0.16	1.39	1.55
Lake County	0.04	2.57	2.61	0.01	2.60	2.61
Lake Tahoe	0.02	1.57	1.59	0.02	1.57	1.59
Mojave Desert	0.37	21.59	21.96	4.53	18.85	23.38
Mountain Counties	0.38	13.41	13.79	0.56	13.29	13.85
North Central Coast	0.78	19.13	19.91	0.53	19.39	19.92
North Coast	0.53	12.88	13.41	0.44	12.94	13.38
Northeast Plateau	0.12	4.31	4.43	0.49	3.82	4.31
Sacramento Valley	2.35	50.46	52.81	2.62	50.15	52.77
Salton Sea	0.53	11.45	11.98	1.63	10.53	12.16
San Diego County	2.01	61.36	63.37	0.74	62.25	62.99
San Francisco Bay Area	4.28	130.43	134.71	1.93	132.31	134.24
San Joaquin Valley	4.77	76.83	81.60	8.70	74.03	82.73
South Central Coast	0.69	28.37	29.06	0.32	28.69	29.01
South Coast	8.24	266.78	275.02	4.54	269.97	274.51
Total	**25.16**	**702.68**	**727.84**	**27.22**	**701.78**	**729.00**

Table 8 – Impact of Proposed Changes on NOx for Selected Areas (TPD)

	2010		2015		2020	
Air Basin	**Baseline**	**Adjusted**	**Baseline**	**Adjusted**	**Baseline**	**Adjusted**
Mojave Desert	28.98	93.22	20.36	49.20	14.87	31.38
Sacramento Valley	75.66	82.25	49.59	54.66	33.79	37.00
Salton Sea	18.63	34.44	14.91	25.35	12.09	18.30
San Diego County	81.33	64.84	56.16	45.27	40.78	33.28
San Francisco Bay Area	209.96	181.57	141.13	125.67	97.97	89.31
San Joaquin Valley	137.39	180.29	92.28	115.75	64.68	77.76
South Coast	370.80	313.28	246.06	210.79	171.60	159.55

Table 9 – Impact of Proposed Changes on PM for Selected Areas (TPD)

	2010		2015		2020	
Air Basin	**Baseline**	**Adjusted**	**Baseline**	**Adjusted**	**Baseline**	**Adjusted**
Mojave Desert	1.58	3.11	1.84	2.93	2.08	3.07
Sacramento Valley	3.67	3.88	3.70	3.83	3.83	3.94
Salton Sea	0.83	1.12	0.87	1.08	0.93	1.10
San Diego County	4.60	4.22	4.68	4.39	4.78	4.54
San Francisco Bay Area	10.38	9.77	10.50	10.11	10.74	10.47
San Joaquin Valley	6.29	7.25	6.44	7.12	6.81	7.24
South Coast	18.36	17.28	19.00	18.16	19.59	18.91

Table 10 – Impact of Proposed Changes on ROG for Selected Areas (TPD)

	2010		2015		2020	
Air Basin	**Baseline**	**Adjusted**	**Baseline**	**Adjusted**	**Baseline**	**Adjusted**
Mojave Desert	10.89	12.42	7.49	8.60	5.47	6.43
Sacramento Valley	24.23	24.45	15.66	15.90	10.66	10.82
Salton Sea	6.35	6.69	4.99	5.35	4.15	4.45
San Diego County	27.62	27.07	18.97	18.50	14.07	13.65
San Francisco Bay Area	73.19	72.48	47.83	47.28	32.15	31.68
San Joaquin Valley	37.74	39.63	25.39	26.69	18.15	19.16
South Coast	113.31	112.07	77.32	76.21	54.26	53.15

Issues

It is important to note that the estimate of HHDDT travel in EMFAC is comprised of activity from California base-plated, as well as out-of-state and out-of country trucks. The estimate of out-of-state truck travel in EMFAC 2002 was derived from the analysis of the 1997 Truck Inventory and Use Survey (TIUS) conducted every five years by the Bureau of Census. Based upon this analysis, the

California native heavy-heavy diesel truck population and the estimate of vehicle miles of travel, were increased by 25%. It is this overall VMT that is compared with MVSTAFF in Table 2.

Analysis of the CALTRANS data suggest that 22 percent of the trucks surveyed last fueled outside of California. It is suggested that this finding corroborate staff's estimate of the impact of out-of-state trucks on California emissions. It is our intent to review the results of the 2002 TIUS when available as well as work with the California Trucking Association (CTA) to refine our estimate of the impact of interstate trucking.

The Southern California Association of Governments (SCAG) maintains a separate model of heavy-duty truck activity and provides this estimate to the ARB. Currently, SCAG is the only transportation planning agency in the State that does so. These estimates are not reflected in the current version of the EMFAC model. The table below compares SCAG's estimate of heavy-heavy truck travel with those of MVSTAFF. As can be seen, the MVSTAFF estimates, and by extension the CALTRANS survey, would suggest that truck traffic in the South Coast is high as estimated by SCAG. Meetings between SCAG and ARB have been initiated to address this issue.

Table 11 – Comparison of SCAG and MVSTAFF VMT Estimates for Heavy-Heavy Duty Diesels in the South Coast Air Basin

Area	SCAG Estimate	MVSTAFF	% Difference
Los Angeles Co.	6,940,384	2,457,180	-64.6%
Orange Co.	1,319,004	454,757	-65.5%
Riverside Co.	1,330,860	984,972	-26.0%
San Bernardino Co.	1,265,275	790,542	-37.5%
Total	**10,855,523**	**4,687,451**	**-56.8%**

Coding Changes

Traditionally, the population and age distribution of HHDDTs is determined through the analysis of California Department of Motor Vehicles (DMV) registration files. The population of trucks by age are assigned to each of the 69 geographic area defined within the model according to where they are registered.

In this update to the emissions inventory, a single statewide estimate of the population of HHDDTs by age will be created and then re-distributed to each of the 69 geographic areas according to the area specific estimates of travel based on MVSTAFF and the CALTRANS Travel Survey.

Backcasts will be performed based on the 1999 calendar year and forecast from the 2002 calendar year estimates. Historic VMT distributions will be based upon MVSTAFF estimates. Forecasts of the HHDDT activity will be based on submissions by the COGs and MPOs. In the absence of HHDDT specific input from the transportation planners, MVSTAFF projections would be used to forecast activity.

Modeling Implications

By establishing a single statewide estimate of HHDDT population, is will be assumed that the age distribution of the fleet is homogeneous regardless of where these vehicles operate. A single statewide mileage accrual rate is therefore required. EMFAC's "ACCR_*" files for vehicle class 8, Heavy HD Trucks (T7) for each area will be overwritten with the values in table 12 below.

Table 12 - HHDDT Mileage Accrual Rates

79473	86416	85542	83729	75789	64989	61330	59650	54834
48525	32017	30816	29615	28415	78038	23612	22410	21209
20009	18808	17607	16406	15205	14005	12804	11602	10402
9202	14800	5598	4398	3197	3482	3482	3482	3482
3482	3482	3482	3482	3482	3482	3482	3482	3482

In the absence of HHDDT specific growth estimates, the population of HHDDT will be grown based on MVSTAFF projections. In order to maintain the overall VMT estimates provided by the transportation planners, the VMT of HHDDTs will first be calculated, and then subtracted from the totals provided by the COGs and MPOs before the VMT matching algorithms are applied.

Tables 13 through 16 (below) provide the proposed distribution of the HHDDT population based on the CALTRANS travel survey for calendar years 1999 through 2002. Table 17 provides the population growth factors to be used in the EMFAC's "**PopG_*"** files.

Table 13 – Heavy-Heavy Duty Diesel Vehicle VMT by County (Year 1999)

GAI	County	% VMT	GAI	County	% VMT
39	Alameda	3.62	30	Placer (SV)	0.55
1	Alpine	0.05	13	Plumas	0.02
7	Amador	0.02	66	Riverside (MD)	1.21
27	Butte	0.90	67	Riverside (MD/SCAB)	1.28
8	Calaveras	0.07	64	Riverside (SS/SCAB)	4.44
28	Colusa	0.45	61	Riverside (SCAB)	3.94
40	Contra Costa	1.17	31	Sacramento	1.91
19	Del Norte	0.01	17	San Benito	1.06
5	El Dorado (LT)	0.05	69	San Bernardino (MD)	9.64
9	El Dorado (MC)	0.01	62	San Bernardino (SCAB)	3.13
48	Fresno	5.52	38	San Diego	2.70
29	Glenn	0.36	43	San Francisco	0.07
20	Humboldt	0.41	53	San Joaquin	3.29
63	Imperial	1.87	56	San Luis Obispo	0.32
2	Inyo	0.30	44	San Mateo	0.14
66	Kern (MD)	2.06	57	Santa Barbara	0.33
49	Kern (SJV)	10.23	45	Santa Clara	1.64
50	Kings	1.96	18	Santa Cruz	0.08
4	Lake	0.04	32	Shasta	1.77
24	Lassen	0.01	14	Sierra	0.01
68	Los Angeles (MD)	0.95	26	Siskiyou	1.44
59	Los Angeles (SCAB)	11.09	33	Solano (SV)	0.64
51	Madera	1.01	46	Solano (SF)	0.63
41	Marin	0.14	22	Sonoma (NC)	0.14
10	Mariposa	0.00	47	Sonoma (SF)	0.20
21	Mendocino	0.61	54	Stanislaus	2.57
52	Merced	3.21	34	Sutter	0.81
25	Modoc	0.01	35	Tehama	1.34
3	Mono	0.21	23	Trinity	0.22
16	Monterey	0.63	55	Tulare	2.09
42	Napa	0.22	15	Tuolumne	0.00
11	Nevada	0.76	58	Ventura	0.65
60	Orange	2.04	36	Yolo	0.79
6	Placer (LT)	0.02	37	Yuba	0.05
12	Placer (MC)	0.89			

Table 14 – Heavy-Heavy Duty Diesel Vehicle VMT by County (Year 2000)

GAI	County	% VMT	GAI	County	% VMT
39	Alameda	3.61	30	Placer (SV)	0.55
1	Alpine	0.05	13	Plumas	0.02
7	Amador	0.02	66	Riverside (MD)	1.20
27	Butte	0.90	67	Riverside (MD/SCAB)	1.27
8	Calaveras	0.07	64	Riverside (SS/SCAB)	4.41
28	Colusa	0.45	61	Riverside (SCAB)	3.91
40	Contra Costa	1.17	31	Sacramento	1.91
19	Del Norte	0.01	17	San Benito	1.06
5	El Dorado (LT)	0.05	69	San Bernardino (MD)	9.69
9	El Dorado (MC)	0.01	62	San Bernardino (SCAB)	3.15
48	Fresno	5.54	38	San Diego	2.70
29	Glenn	0.36	43	San Francisco	0.07
20	Humboldt	0.41	53	San Joaquin	3.30
63	Imperial	1.87	56	San Luis Obispo	0.32
2	Inyo	0.30	44	San Mateo	0.14
66	Kern (MD)	2.08	57	Santa Barbara	0.33
49	Kern (SJV)	10.31	45	Santa Clara	1.64
50	Kings	1.96	18	Santa Cruz	0.08
4	Lake	0.04	32	Shasta	1.77
24	Lassen	0.01	14	Sierra	0.01
68	Los Angeles (MD)	0.94	26	Siskiyou	1.44
59	Los Angeles (SCAB)	11.00	33	Solano (SV)	0.64
51	Madera	1.01	46	Solano (SF)	0.63
41	Marin	0.14	22	Sonoma (NC)	0.14
10	Mariposa	0.00	47	Sonoma (SF)	0.20
21	Mendocino	0.61	54	Stanislaus	2.57
52	Merced	3.21	34	Sutter	0.81
25	Modoc	0.01	35	Tehama	1.34
3	Mono	0.21	23	Trinity	0.22
16	Monterey	0.63	55	Tulare	2.09
42	Napa	0.22	15	Tuolumne	0.00
11	Nevada	0.76	58	Ventura	0.65
60	Orange	2.04	36	Yolo	0.79
6	Placer (LT)	0.02	37	Yuba	0.05
12	Placer (MC)	0.89			

*GAI = Geographic Area Index

Table 15 – Heavy-Heavy Duty Diesel Vehicle VMT by County (Year 2001)

GAI	County	% VMT	GAI	County	% VMT
39	Alameda	3.61	30	Placer (SV)	0.55
1	Alpine	0.05	13	Plumas	0.02
7	Amador	0.02	66	Riverside (MD)	1.20
27	Butte	0.90	67	Riverside (MD/SCAB)	1.27
8	Calaveras	0.07	64	Riverside (SS/SCAB)	4.42
28	Colusa	0.45	61	Riverside (SCAB)	3.92
40	Contra Costa	1.17	31	Sacramento	1.91
19	Del Norte	0.01	17	San Benito	1.06
5	El Dorado (LT)	0.05	69	San Bernardino (MD)	9.70
9	El Dorado (MC)	0.01	62	San Bernardino (SCAB)	3.15
48	Fresno	5.55	38	San Diego	2.70
29	Glenn	0.36	43	San Francisco	0.07
20	Humboldt	0.41	53	San Joaquin	3.31
63	Imperial	1.87	56	San Luis Obispo	0.32
2	Inyo	0.30	44	San Mateo	0.14
66	Kern (MD)	2.08	57	Santa Barbara	0.33
49	Kern (SJV)	10.32	45	Santa Clara	1.64
50	Kings	1.96	18	Santa Cruz	0.08
4	Lake	0.04	32	Shasta	1.77
24	Lassen	0.01	14	Sierra	0.01
68	Los Angeles (MD)	0.94	26	Siskiyou	1.44
59	Los Angeles (SCAB)	10.97	33	Solano (SV)	0.64
51	Madera	1.01	46	Solano (SF)	0.63
41	Marin	0.14	22	Sonoma (NC)	0.14
10	Mariposa	0.00	47	Sonoma (SF)	0.20
21	Mendocino	0.61	54	Stanislaus	2.57
52	Merced	3.21	34	Sutter	0.81
25	Modoc	0.01	35	Tehama	1.34
3	Mono	0.21	23	Trinity	0.22
16	Monterey	0.63	55	Tulare	2.09
42	Napa	0.22	15	Tuolumne	0.01
11	Nevada	0.76	58	Ventura	0.65
60	Orange	2.04	36	Yolo	0.79
6	Placer (LT)	0.02	37	Yuba	0.05
12	Placer (MC)	0.89			

*GAI = Geographic Area Index

Table 16 – Heavy-Heavy Duty Diesel Vehicle VMT by County (Year 2002)

GAI	County	% VMT	GAI	County	% VMT
39	Alameda	3.61	30	Placer (SV)	0.55
1	Alpine	0.05	13	Plumas	0.02
7	Amador	0.02	66	Riverside (MD)	1.21
27	Butte	0.90	67	Riverside (MD/SCAB)	1.28
8	Calaveras	0.07	64	Riverside (SS/SCAB)	4.44
28	Colusa	0.45	61	Riverside (SCAB)	3.93
40	Contra Costa	1.17	31	Sacramento	1.91
19	Del Norte	0.01	17	San Benito	1.06
5	El Dorado (LT)	0.05	69	San Bernardino (MD)	9.71
9	El Dorado (MC)	0.01	62	San Bernardino (SCAB)	3.16
48	Fresno	5.55	38	San Diego	2.70
29	Glenn	0.36	43	San Francisco	0.07
20	Humboldt	0.41	53	San Joaquin	3.31
63	Imperial	1.87	56	San Luis Obispo	0.32
2	Inyo	0.30	44	San Mateo	0.14
66	Kern (MD)	2.09	57	Santa Barbara	0.33
49	Kern (SJV)	10.34	45	Santa Clara	1.63
50	Kings	1.96	18	Santa Cruz	0.08
4	Lake	0.04	32	Shasta	1.77
24	Lassen	0.01	14	Sierra	0.01
68	Los Angeles (MD)	0.93	26	Siskiyou	1.44
59	Los Angeles (SCAB)	10.94	33	Solano (SV)	0.64
51	Madera	1.01	46	Solano (SF)	0.63
41	Marin	0.14	22	Sonoma (NC)	0.14
10	Mariposa	0.00	47	Sonoma (SF)	0.20
21	Mendocino	0.61	54	Stanislaus	2.57
52	Merced	3.21	34	Sutter	0.81
25	Modoc	0.01	35	Tehama	1.34
3	Mono	0.21	23	Trinity	0.22
16	Monterey	0.63	55	Tulare	2.09
42	Napa	0.22	15	Tuolumne	0.01
11	Nevada	0.76	58	Ventura	0.65
60	Orange	2.04	36	Yolo	0.79
6	Placer (LT)	0.02	37	Yuba	0.05
12	Placer (MC)	0.89			

*GAI = Geographic Area Index

Appendix A

ARB STAFF ANALYSIS

Development of Geo-Coding and Network Analyst

Application:

Determination of Heavy Duty Truck Vehicle Miles of Travel (VMT) in the 58 Counties of California

Prepared by

Augustus Pela

Pranay Avlani

This section contains the ARB staff analysis of the study of the distribution of VMT by county using GPS available data and the utilization of GIS for the codification of the routes driven by trucks.

Summary and Conclusions

Heavy-duty trucks are defined as having a gross vehicle weight in excess of 8,500 pounds. The EMFAC model segregates these trucks into four distinct classes:

- Light-Heavy-Duty Truck 1 or T4s include those trucks weighing between 8,500 and 10,000 pounds
- Light-Heavy-Duty Truck 2 or T5s include those trucks weighing between 10,001 and 14,000 pounds
- Medium-Heavy-Duty Trucks (T6) are those weighing between 14,001 and 33,000 pounds and
- Heavy-Heavy-Duty Trucks (T7) are those weighing in excess of 33,000 pounds.

Heavy-Heavy Duty Diesel Trucks represent about 23% of the total heavy-duty truck population and contribute approximately 44% of the vehicle miles of travel.

It is feasible to geo-code travel origin-destination (O-D) pairs of a given trip derived from in-person survey of drivers. After geo-coding the O-D, the likely route driven can be determined using geographic information system (GIS) tools. A protocol was developed using actual routes collected by global positioning system (GPS) recorders to validate the results of the GIS route mapping. The correlation of this validation yielded a root mean square (R^2) value of 0.98. This provided staff the confidence to analyze approximately 8,200 surveyed O-D trips involving heavy-duty trucks in California. The results of this analysis were used to determine the relative amount of heavy-duty truck (HDT 8,500+ Gross Vehicle Weight (GVW)) and heavy-heavy-duty truck (HHDT 33,000+ GVW) vehicle miles of travel (VMT) accumulated in each of the 58 counties of the state.

The statewide percent of HDT and HHDT VMT by county results were compared with the CALTRANS Motor Vehicle Stock, Travel and Fuels Forecast (MVSTAFF), EMFAC 2002 and CALTRANS count studies. Similarly, air basin GIS results were compared to EMFAC 2002 version 2.2.

The correlation of the surveyed O-D results were markedly better for MVSTAFF, showing an R^2 value of 0.91, compared to R^2 values of 0.49 and 0.82 for the EMFAC 2002 and CALTRANS count studies, respectively.

Based on the HHDT O-D survey, it is reasonable to conclude that the use of MVSTAFF determination of fractional VMT for each of the 58 counties may be a better choice for use in emissions modeling since MVSTAFF can provide historic and current estimates of travel.

Statement of Problem

1. Post process a data set derived from a direct survey of truckers. Use the survey origin and destination locations of the trip to determine the most likely path of travel.

2. Use the likely path of travel to estimate the fractional heavy-duty truck travel in each county of the state.

The scope of the problem is depicted in Figure A-1 (all figures appear at the end of the text).

Background

The fractional VMT in each county is one of several inputs required for the on-road mobile source emissions inventory program (EMFAC). The EMFAC model currently uses motor vehicle registration data in the determination a county's VMT. The use of motor vehicle registration for estimating HHDT travel has been questioned and may not be the best representation of where the actual driving activity takes place.

This document presents the analysis of two new data sets, each capable of determining the probable routes driven. The first was derived by mapping a geographical origin-destination (O-D) survey of truckers. The survey collected information by direct, in-person interview with truck drivers throughout the State.

The second data set contained real-time routes derived from the GPS instrumentation of trucks. The second data set was primarily used to validate the methodology of GIS mapping of the O-D data to probable routes.

It is worth mentioning that although the methodology for the determination of the routes would equally apply to light-duty and heavy-duty vehicles, this study focuses on heavy-duty vehicles only because of the availability of data.

The mapping protocol utilized the ESRI Network Analyst[R] tool.

This report describes the data sets, the data preparation and data reduction routines, software code development, the application of the Network Analyst[R], and statistical comparisons. A pictorial illustration of the process is shown in Figure A-2.

Data Sets

- **CALTRANS Heavy-Duty Truck Survey**:

In 1999, approximately 8,200 truck driver interviews were conducted at 41 CHP sites, 4 agricultural inspection sites, and 5 rest areas, for a total of 50 sites throughout California. The interviews resulted in a robust data set intended for the development of a Heavy-Duty Truck Statewide Travel Demand Model, the development of which is on hold because of lack of funding.

A complete report of the study may be found in "FINAL REPORT 1999 HEAVY-DUTY TRUCK TRAVEL MODEL SURVEY", prepared for California Department of Transportation, System Information Program, Office of Travel Forecasting and Analysis, by Strategic Consulting & Research, Inc. (http://www.dot.ca.gov/hq/tsip/TSIPPDF/Heavy_Duty_Truck2001.pdf)

This data set contains approximately 8,200 distinct origin-destination (O-D) pairs with associated geographic position coordinates and the location of the survey site where the driver was interviewed. After extensive screening of the survey database, approximately 8,100 of the O-D pairs were determined to be usable for this analysis. Additional characteristics of the survey data set are shown in Figure A-3.

- **GPS Data Set: Battelle Heavy-Duty Truck Study**

Under contract to the Air Resources Board, representatives of the Batelle Memorial Institute procured and instumented 140 heavy-duty trucks with GPS data recording devices capable of measuring speed, distance, time and location of travel. The trucks were procured throughout California and accumulated nearly 87,000 vehicle miles of travel yielding a data set of approximately 8 million second-by-second geographic position coordinates. Only 72 of the 140 vehicles procured and instrumented were heavy-heavy duty trucks. A complete description of this study may be found in "Final Report Heavy Duty Truck Activity Data" by Battelle, March 31, 1999. The Battelle study represented an "opportunity" sampling of truck activity and was not representative of the heavy-duty fleet as a whole. In contrast to the CALTRANS survey data set, this project was limited in the number of trips captured. While this study provided a glimpse of the heavy-truck VMT distribution across county boundaries, it was not considered robust enough to be used to develop county-by-county statewide heavy-duty truck travel estimates.

A sample of the Battelle data set is shown in Figure A-4.

Data Preparation and Methodology

- **Converting the grid system:**

The mapping characteristics of the survey data were geo-coded in the Universal Transverse Mercator (UTM) projection grid system. The map coordinates had to be converted to the “Teale-Albers” coordinate system in order to have the origin and destination coordinates be compatible with the roadway network made available for this purpose.

- **Geo-coding the Survey Location:**

Although the coordinates of the origin-destination of every trip was present in the original data set, the coordinate locations for the 41 CHP sites for the interview were not provided. Using the survey location address, the survey location coordinates were derived.

- **Convert raw data in Microsoft Excel to Adobe DBF format:**

The raw data was stored in Excel format and was converted to the DBF format for use with ArcView software.

- **Verification that X,Y (O-D) pairs fall within the map:**

Once the above steps were successfully accomplished, the O-D pairs were plotted using Arc View 8.1. This step was necessary due to software inconsistencies between Arc View 8.1 and Arc View 3.2. This ensured that the Network Analyst application of Arc View 3.2 could be used in developing the probable path driven by a trucker.

- **Validation Methodology**

Two separate procedures were used to validate the network routing results. First, the original survey asked the driver to estimate the number of miles traveled on the day of the survey. We compared this estimate with the network routing miles calculated.

Secondly, a subset of Battelle GPS data where miles driven had been previously established, was compared to its network routing miles when only the origin and destination points of the trip were specified and geo-coded. The result of this comparison is shown in the “Validation Test_Trip Miles” graph below. The results show a good correlation with an R^2 value of 0.98.

Software Code Development

The processing of each O-D for the approximately 8,100 routes was projected to be an extensive and intensive task. Therefore, a software code using Arc View 3.2 for batch processing the routes was developed, tested and implemented. The code was written in the "script avenue" language. The source code is presented in Appendix B.

Application of Network Analyst

- **Activating Network Analyst:**

In the Arc View 3.2 "file" menu, click on the "extension" tool to activate the networking analyst capabilities.

The following steps should be performed before running the script code:

1. Activate the Teale Abers Map
2. Activate the trip table
3. Activate the script code itself

Analysis of Routing Output

To date, the following results have been generated using the survey data set. In addition, identical analyses have been generated for MVSTAFF, EMFAC 2002, and CALTRANS Truck Count data with the purpose of comparing the results.

- Table 1…Statewide Percent of HDT VMT by County

It is worth noting that other analyses such as intra-county VMT (trips originating and ending in the same county) are being developed.

Results

First, there was good agreement in the validation process as shown in Graph 1. This result established the confidence of this methodology.

A comparison of the next three graphs show that the MVSTAFF more closely represents the distribution of truck travel in the state using the analysis of the truck survey data as a representative snapshot of activity.

Figure A-1: Scope of problem.

Problem: Post process origin to destination data such most likely path of travel is determined. Identify fraction of in each county of

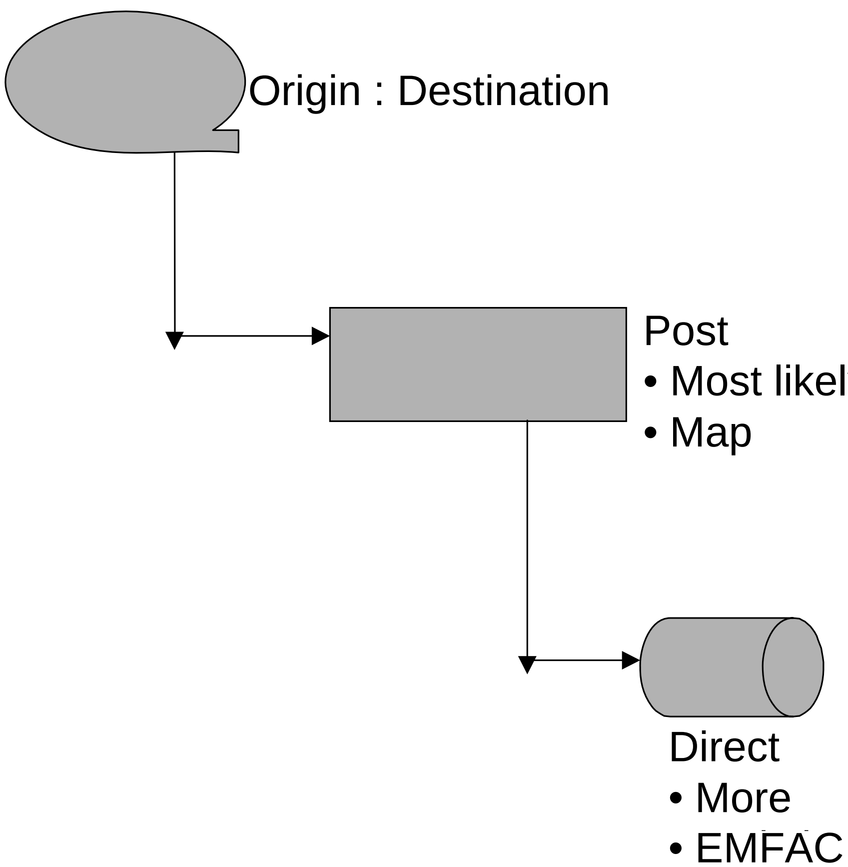


Figure A-2: Flow Diagram of Analysis and Result Documentation

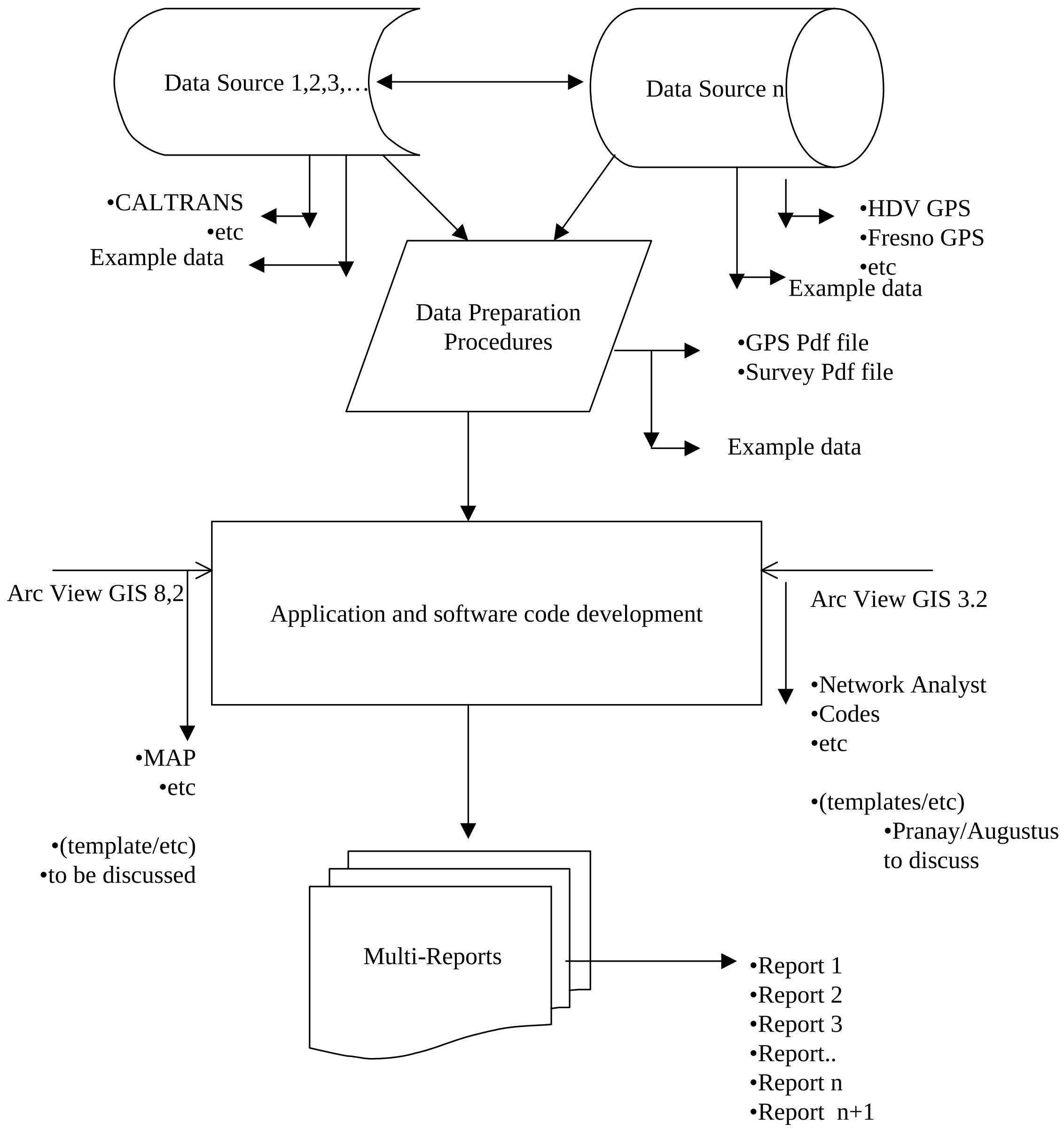


Figure A-3: Caltrans Survey Data Sample

ID	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18
2102612101	10/26/99	18991231	1	CURRY	1	CASTAIC - NORTH	I-5	1	2	3	5	1	2	100	44530	2	24
2102612102	10/26/99	18991231	1	RM	1	CASTAIC - NORTH	I-5	1	2	0	5	1	2	100	77000	1	3
2102612103	10/26/99	18991231	1	CURRY	1	CASTAIC - NORTH	I-5	1	2	3	5	1	1	0	0	0	28
2102612104	10/26/99	18991231	1	RM	1	CASTAIC - NORTH	I-5	1	2	2	5	3	2	60	60000	2	36
2102612105	10/26/99	18991231	1	CURRY	1	CASTAIC - NORTH	I-5	1	2	3	5	2	2	100	65000	1	21
2102612106	10/26/99	18991231	1	RM	1	CASTAIC - NORTH	I-5	1	2	3	5	1	2	5	33000	2	7
2102612107	10/26/99	18991231	1	CURRY	1	CASTAIC - NORTH	I-5	1	2	3	5	1	2	100	57693	2	40
2102612109	10/26/99	18991231	1	CURRY	1	CASTAIC - NORTH	I-5	1	2	3	5	1	2	25	43000	2	21
2102612110	10/26/99	18991231	1	RM	1	CASTAIC - NORTH	I-5	1	2	2	5	1	1	0	0	0	5
2102612111	10/26/99	18991231	1	CURRY	1	CASTAIC - NORTH	I-5	1	2	3	5	1	2	75	72000	1	7
2102612112	10/26/99	18991231	1	RM	1	CASTAIC - NORTH	I-5	1	1	2	5	4	2	100	79000	1	23
2102612113	10/26/99	18991231	1	CURRY	1	CASTAIC - NORTH	I-5	1	2	3	5	1	2	100	76880	1	41
2102612114	10/26/99	18991231	1	RM	1	CASTAIC - NORTH	I-5	1	2	3	5	1	1	0	0	0	3
2102612115	10/26/99	18991231	1	CURRY	1	CASTAIC - NORTH	I-5	1	1	3	5	1	2	100	73900	1	7
2102612116	10/26/99	18991231	1	RM	1	CASTAIC - NORTH	I-5	1	2	2	5	1	2	50	45000	2	40
2102612117	10/26/99	18991231	1	CURRY	1	CASTAIC - NORTH	I-5	1	2	3	5	3	1	0	0	0	40
2102612119	10/26/99	18991231	1	CURRY	1	CASTAIC - NORTH	I-5	1	2	3	5	1	2	100	55000	2	7

Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29
S CENTRAL AVE & E 61ST ST	LOS ANGELES	CA	90001	1	1			18991231	1	L
PILOT TRUCKSTOP	PALM SPRINGS	CA	0	1	3			18991231	1	L
FIRESTONE BLVD & GARFIELD AVE	SOUTH GATE	CA	0	1	4			18991231	1	L
	SYLMAR	CA	0	1	1			18991231	1	J
W OCEAN BLVD & N PICO AVE	LONG BEACH	CA	90802	1	4			18991231	1	A
S ANAHEIM BLVD & W BALL RD	ANAHEIM	CA	92805	1	1			18991231	1	L
1385 S ROWAN AVE	LOS ANGELES	CA	90023	1	1			18991231	1	L
SR-60 & NOGALES ST	ROWLAND HEIGHTS	CA	91748	1	1			18991231	1	L
E 76TH ST & ALAMEDA ST	LOS ANGELES	CA	90001	1	2			18991231	1	F
BEACH BLVD & COMMONWEALTH	BUENA PARK	CA	90621	1	1			18991231	1	L
7TH STANDARD RD & BEECH AVE	SHAFTER	CA	93263	1	1			18991231	2	M
S EAST ST & E SANTA ANA AVE	ANAHEIM	CA	92805	1	1			18991231	1	L
2187 E OLYMPIC BLVD	LOS ANGELES	CA	90021	1	4			18991231	1	G
JURUPA ST & I-15	ONTARIO	CA	91761	1	1			18991231	1	L
FOSTER GLEN & DON'T KNOW	EL MONTE	CA	0	1	1			18991231	1	F
ROXFORD ST & SAN FERNANDO RD	SUN VALLEY	CA	0	1	4			18991231	1	L

Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	OTHQ41
851 N HARVARD AVE	LINDSAY	CA	93247	2	18991231	2	L	150	2	150		
TRUCK STOP	CORNING	CA	0	4	18991231	2	N	500	2	500		
SR-41 & I-5	KETTLEMAN CITY	CA	0	4	18991231	2	N	225	3	450		
CASTAIC RD	CASTAIC	CA	0	2	18991231	1	J	25	11	250		
28305 LIVINGSTON	VALENCIA	CA	0	2	18991231	1	L	67	2	67		
2240 FILBERT ST	OAKLAND	CA	0	2	18991231	2	H	500	2	500		
1702 SCHUSTER RD	DELANO	CA	93215	2	18991231	2	L	143	2	143		
1015 PERFORMANCE DR	STOCKTON	CA	95203	2	18991231	2	L	325	2	325		
99TH & CALIFORNIA ST	BAKERSFIELD	CA	0	1	18991231	2	M	125	2	125		
3741 GOLD RIVER LANE	STOCKTON	CA	95215	2	18991231	2	L	400	2	400		
STANDARD ST & GULF ST	BAKERSFIELD	CA	93308	2	18991231	2	M	137	2	137		
HWY 152 & I-5	LOS BANOS	CA	0	4	18991231	2	N	250	2	250		
SR-46 & I-5	LOST HILLS	CA	0	4	18991231	2	N	200	2	200		
S ORANGE AVE & E JENSEN AVE	FRESNO	CA	93725	2	18991231	2	L	240	2	240		
3695 S WILLOW AVE	FRESNO	CA	93725	2	18991231	2	L	250	2	250		
S UNION AVE & FAIRVIEW RD	BAKERSFIELD	CA	0	4	18991231	2	E	95	2	95		
I-5 & SR-44	REDDING	CA	96002	4	18991231	2	N	550	2	550		

Q42	Q43	Q44	Q45	Q46	Q47	Q48	Q60	Q61	Q62	Q63	Q64	Q65	Q74	Q75	Q76
33.98430	-118.25660	A	36.21370	-119.08270	A	10	FALL	3	12	3	3	1	LA	LOS ANGELES	37
33.82730	-116.53040	C	39.92420	-122.17820	C	10	FALL	3	12	8	8	1	RIV	RIVERSIDE	65
33.94920	-118.16520	A	35.98200	-119.96100	B	10	FALL	3	1	4	8	2	LA	LOS ANGELES	37
34.31460	-118.46270	C	34.48190	-118.61380	B	10	FALL	3	7	1	4	5	LA	LOS ANGELES	37
33.76700	-118.20950	A	34.39630	-118.56430	C	10	FALL	3	12	1	1	1	LA	LOS ANGELES	37
33.81820	-117.90790	A	37.81520	-122.28050	A	10	FALL	3	2	8	8	1	ORA	ORANGE	59
34.01670	-118.18730	A	35.73220	-119.24080	B	10	FALL	3	12	3	3	1	LA	LOS ANGELES	37
33.99410	-117.88870	B	37.95360	-121.32780	C	10	FALL	3	4	6	6	1	LA	LOS ANGELES	37
33.97190	-118.23420	A	35.36870	-118.99530	C	10	FALL	3	1	2	2	1	LA	LOS ANGELES	37
33.86990	-117.99820	A	37.91160	-121.21540	A	10	FALL	3	9	7	7	1	ORA	ORANGE	59
35.44170	-119.26100	A	35.39360	-119.04750	A	10	FALL	3	12	3	3	1	KER	KERN	29
33.83360	-117.90110	A	37.05660	-120.97000	B	10	FALL	3	12	4	4	1	ORA	ORANGE	59
34.02630	-118.23370	A	35.61630	-119.65330	B	10	FALL	3	1	3	3	1	LA	LOS ANGELES	37
34.04810	-117.55020	B	36.70680	-119.76220	A	10	FALL	3	12	4	4	1	SBD	SAN BERNARDINO	71
34.07940	-118.01620	C	36.68220	-119.72670	A	10	FALL	3	6	4	4	1	LA	LOS ANGELES	37
34.30990	-118.47320	A	35.30300	-119.00270	A	10	FALL	3	1	2	2	1	LA	LOS ANGELES	37
33.90190	-118.31360	A	40.58540	-122.36040	B	10	FALL	3	12	8	8	1	LA	LOS ANGELES	37

Q78	Q79	Q81	Q82	Q83	Q84	Q85	Q86	Q87	Q88	Q89	Q90	Q91	Q92	Q94	Q95	Q96	Q97	Q98	Q99	AX_METERS	AY_METERS
13	7	1	1	1	1	12	12	19	13	7	54	16	6	TUL	TULARE	107	Tulare	16	6	161090.20641500000	-446598.29316800000
13	8	1	1	8	1	12	14	33	13	8	52	17	2	TEH	TEHAMA	103	Other	17	2	321174.72440800000	-459614.42281500000
13	7	1	1	4	1	12	14	19	13	7	16	17	6	KIN	KINGS	31	Other	17	6	169609.87837500000	-450331.31351300000
13	7	1	1	1	1	10	10	19	13	7	19	13	7	LA	LOS ANGELES	37	SCAG	13	7	141454.21697400000	-410290.07015600000
13	7	1	1	1	1	1	12	19	13	7	19	13	7	LA	LOS ANGELES	37	SCAG	13	7	165896.83665000000	-470612.23238000000
13	12	1	1	8	1	12	8	30	13	12	1	7	4	ALA	ALAMEDA	1	MTC	7	4	193711.77114400000	-464363.70944900000
13	7	1	1	3	1	12	12	19	13	7	15	5	6	KER	KERN	29	Kern	5	6	167424.05541600000	-442885.07855300000
13	7	1	1	6	1	12	12	19	13	7	39	10	10	SJ	SAN JOAQUIN	77	San Joaguin	10	10	195054.84198700000	-444820.51791400000
13	7	1	1	2	1	6	13	19	13	7	15	5	6	KER	KERN	29	Kern	5	6	163185.34375300000	-447935.11423400000
13	12	1	1	7	1	12	12	30	13	12	39	10	10	SJ	SAN JOAQUIN	77	San Joaguin	10	10	185230.93289700000	-458811.99690200000
5	6	1	1	3	1	13	13	15	5	6	15	5	6	KER	KERN	29	Kern	5	6	67025.87283610000	-286051.49078500000
13	12	1	1	4	1	12	14	30	13	12	24	6	10	MER	MERCED	47	Merced	6	10	194303.48908600000	-462642.39352800000
13	7	1	1	3	1	7	14	19	13	7	15	5	6	KER	KERN	29	Kern	5	6	163119.13764100000	-441901.30396900000
13	8	1	1	4	1	12	12	36	13	8	10	4	6	FRE	FRESNO	19	Fresno	4	6	226166.31328900000	-438080.51089200000
13	7	1	1	4	1	6	12	19	13	7	10	4	6	FRE	FRESNO	19	Fresno	4	6	183079.41776400000	-435615.19385700000
13	7	1	1	2	1	12	5	19	13	7	15	5	6	KER	KERN	29	Kern	5	6	140496.54410500000	-410827.10915500000
13	7	1	1	8	1	12	14	19	13	7	45	14	2	SHA	SHASTA	89	Shasta	14	2	155986.52333600000	-455831.27126600000
13	8	1	1	8	1	12	13	33	13	8	24	6	10	MER	MERCED	47	Merced	6	10	222484.57820400000	-449492.25996300000

Q# = Question or field within the California Truck Travel Survey

Q1 Survey ID **Q2** Date **Q3** Time
Q4 AM/PM **Q5** Surveyor **Q6** CHP/AG
Q7 Facility Name **Q8** Fwy/Route
Q9 Direction of Travel **Q10** Hazardous Materials Signage
Q11 Truck Type **Q12** Number of Axles
Q13 Truck Body **Q14** Is the truck empty now?
Q15 What % of total capacity are you carrying now?
Q16 What is this truck's weight in cargo? (pounds)
Q17 Would it be over 60,000-33,000 pounds? Under 33,000 pounds?
Q18 What is the primary cargo being carried?
Q19 Where did the truck last stop to load, unload or start the day?
Q20 City **Q21** State **Q22** Zip
Q23 Was this your starting location?
Q24 Did you load, or unload at this location, or both? Neither?
Q25 What time did you arrive and depart that location?
Q26 AM/PM **Q27** Depart **Q28** AM/PM
Q29 What type of facility or terminal was that?
Q30 Address/Cross Streets or nearest intersetion
Q31 City **Q32** State **Q33** Zip
Q34 Will you load or unload cargo at this location, or both?
Q35 At what time will you arrive there?
Q36 AM/PM **Q37** What type of facility or terminal is this?
Q38 What is the distance between the most recent and next stops that we just Identified? (miles)
Q39 How many total stops will you make today for loading or unloading Including your starting and ending points?
Q40 How many total miles will your drive the truck today from start to finish?
Q41 In which state did you last fuel your truck? CA / NV / AZ / OR / MX /Other

Facility Codes

A. Marine port B. Rail facility C. Air Cargo Facility
D. Truck terminal/Reload Facility E. Residential
F. Manufacturing G. Wholesale H. Retail Store
I. Hospital/Medical J. Public/Government K. Office Services
L. Distribution Center M. Agricultural Processing/Packaging
M. Truckstop, Roadside rest area, or motel/hotel
O. Other P. Don't Know (Do not State)

Figure A-4: Battelle GPS Sample data

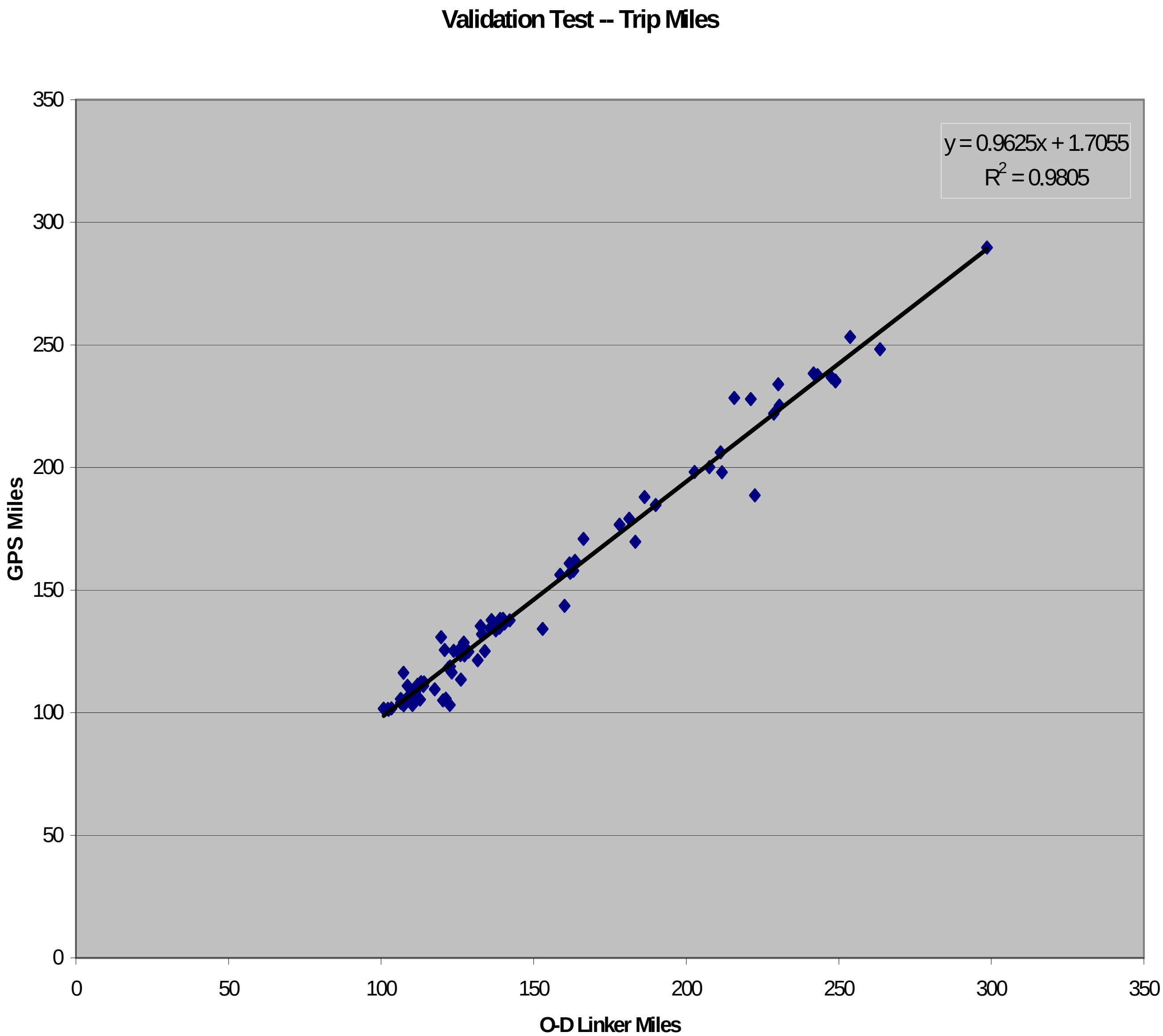
ID	CASENO	TRUCKNO	TRIPNO	CAL_LEN	NET_LEN	R = NET/CAL	XS	YS	XM	YM	XE
1	102	501	1	55.92	45.10	81%	-181512.887970	-42263.666310	-161117.074160	-36622.321310	-147948.104890
2	102	501	3	63.99	42.79	67%	-147967.118610	-8931.287160	-161204.151560	-36615.081300	-147800.280970
3	102	501	4	51.62	41.35	80%	-147825.114300	-8993.849210	-161675.555120	-33662.907340	-181541.160370
5	102	501	6	56.42	44.94	80%	-181546.339000	-42220.687480	-161085.500770	-36584.015960	-147751.098460
6	102	501	7	54.50	38.31	70%	-146498.654280	-15694.879440	-161044.615030	-36291.277720	-147892.048390
7	102	501	8	49.54	38.75	78%	-147817.539580	-8962.852800	-163040.330810	-33694.175300	-183110.395350
8	102	501	10	50.29	41.50	83%	-181513.564020	-42294.784700	-161985.758750	-33673.570430	-148210.884000
9	102	501	11	50.75	41.50	82%	-148160.298950	-8932.297270	-159019.992510	-33690.576230	-181448.762250
10	102	501	13	57.17	44.57	78%	-181523.607830	-42270.104790	-161151.429420	-36211.387540	-147922.670340
11	102	501	14	112.37	41.57	37%	-148384.299170	-8938.312510	-147920.737060	-8939.894490	-181538.999590
13	202	705	1	0.54	0.05	9%	169744.300530	-445816.934660	169790.898450	-445741.702460	169747.737880
14	202	705	3	6.33	5.51	87%	169841.171930	-445808.400390	165135.133000	-445990.471040	160886.992700
15	202	705	5	7.22	5.59	77%	160913.050490	-446412.958110	164624.357840	-446005.633070	169797.085600
16	202	705	8	0.42	0.04	10%	169769.737900	-445841.957550	169760.821710	-445811.067520	169773.690600
17	202	705	9	19.95	17.14	86%	169704.490590	-445813.268560	166199.538100	-458854.918720	155945.007340
18	202	705	10	20.67	17.16	83%	155959.048190	-462249.638120	166915.666240	-458697.120150	169737.940970

ID	Identification Number
CASENO	Batelle's Case ID
TRUCKNO	Truck Number
TRIPNO	Trip Number
CAL_LEN	Calculated Length between two successive readings
NET_LEN	Network Length – length of route calculated by ArcView
R=NET/CAL	Ratio of NET_LEN and CAL_LEN
XS, YS	X and Y coordinates for the starting point of the trip
XM, YM	X and Y coordinates for the midpoint of the trip
XE, YE	X and Y coordinates for the endpoint of the trip

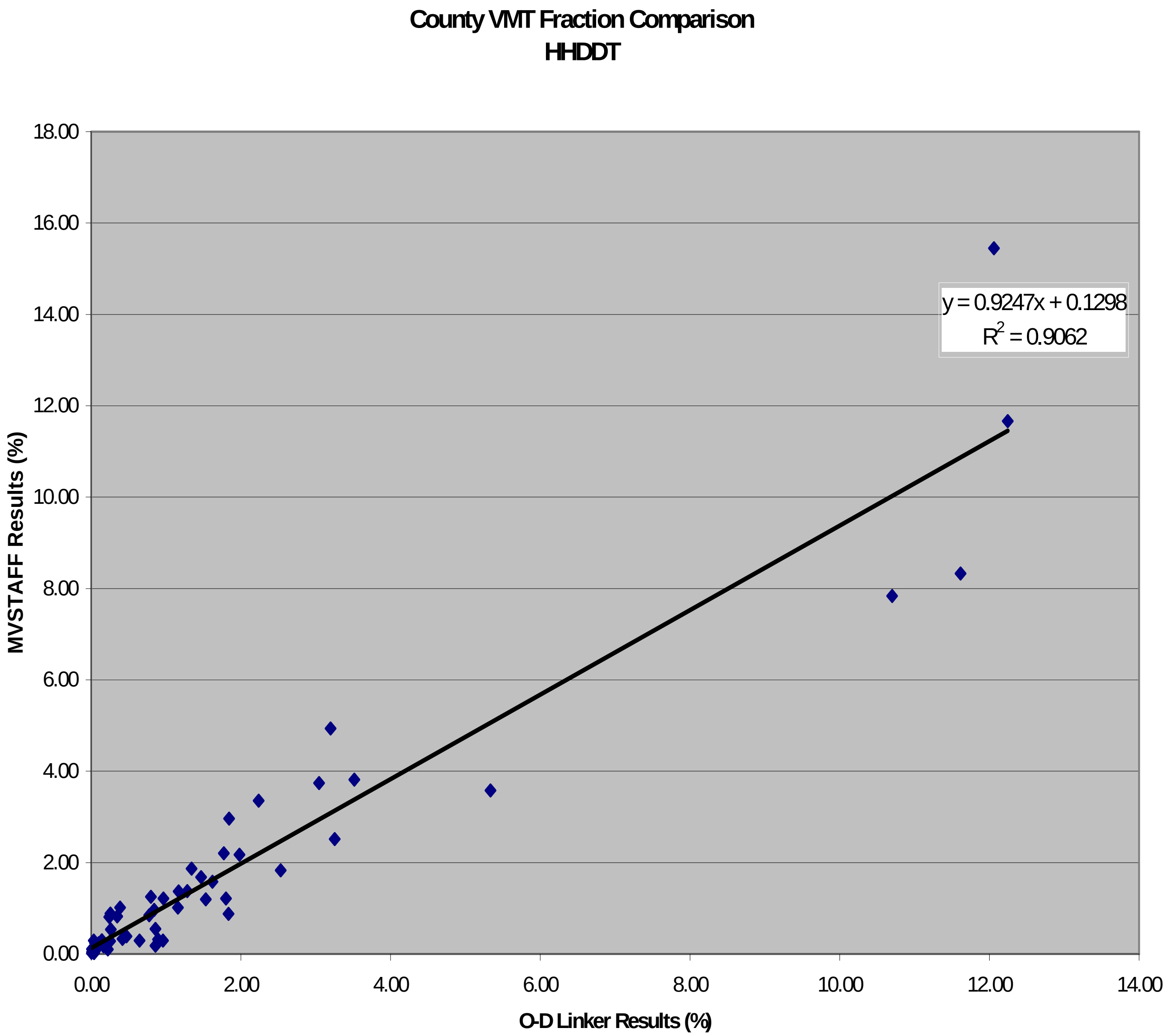
Table A-1: Statewide Percent of HHDDT VMT by County

COUNTY	CALTRANS HDTSurvey (March 2001)	MVSTAFF 2000 Cal Yr.	EMFAC2002 2000 Cal Yr.	CT Truck (Dec 2002)
ALAMEDA	3.04%	3.74%	4.90%	3.66%
ALPINE	0.04%	0.02%	0.00%	0.02%
AMADOR	0.06%	0.11%	0.14%	0.12%
BUTTE	0.89%	0.32%	0.54%	0.38%
CALAVERAS	0.03%	0.07%	0.11%	0.09%
COLUSA	0.35%	0.82%	0.25%	0.77%
CONTRA COSTA	1.47%	1.68%	2.06%	1.41%
DEL NORTE	0.02%	0.07%	0.06%	0.10%
EL DORADO	0.05%	0.24%	0.30%	0.29%
FRESNO	5.33%	3.58%	3.69%	2.85%
GLENN	0.26%	0.54%	0.15%	0.55%
HUMBOLDT	0.47%	0.39%	0.61%	0.44%
IMPERIAL	1.80%	1.22%	1.18%	1.24%
INYO	0.25%	0.28%	0.09%	0.23%
KERN	11.62%	8.33%	3.78%	6.45%
KINGS	1.83%	0.88%	0.57%	0.80%
LAKE	0.05%	0.10%	0.11%	0.12%
LASSEN	0.04%	0.29%	0.10%	0.30%
LOS ANGELES	12.06%	15.45%	21.82%	17.27%
MADERA	0.97%	1.22%	0.59%	1.04%
MARIN	0.42%	0.33%	0.33%	0.48%
MARIPOSA	0.00%	0.03%	0.03%	0.03%
MENDOCINO	0.64%	0.29%	0.43%	0.31%
MERCED	3.25%	2.52%	1.55%	1.96%
MODOC	0.01%	0.11%	0.06%	0.14%
MONO	0.17%	0.17%	0.07%	0.14%
MONTEREY	1.17%	1.37%	1.76%	1.44%
NAPA	0.14%	0.30%	0.37%	0.22%
NEVADA	0.86%	0.55%	0.19%	0.37%
ORANGE	2.24%	3.36%	6.01%	5.06%
PLACER	1.53%	1.20%	0.64%	0.99%
PLUMAS	0.03%	0.11%	0.21%	0.15%
RIVERSIDE	10.70%	7.84%	5.00%	8.43%
SACRAMENTO	1.84%	2.96%	4.18%	2.83%
SAN BENITO	0.96%	0.29%	0.30%	0.28%
SAN BERNARDINO	12.24%	11.66%	5.26%	10.21%
SAN DIEGO	3.51%	3.82%	7.31%	5.50%
SAN FRANCISCO	0.10%	0.24%	2.46%	0.33%
SAN JOAQUIN	3.20%	4.94%	2.97%	3.84%
SAN LUIS OBISPO	0.26%	0.88%	0.67%	1.00%
SAN MATEO	0.24%	0.81%	1.48%	1.31%
SANTA BARBARA	0.39%	1.02%	0.88%	1.16%
SANTA CLARA	1.77%	2.20%	4.20%	2.68%
SANTA CRUZ	0.16%	0.20%	0.67%	0.32%
SHASTA	1.62%	1.58%	0.63%	1.35%
SIERRA	0.05%	0.07%	0.02%	0.07%
SISKIYOU	1.29%	1.38%	0.21%	1.12%
SOLANO	1.34%	1.87%	1.07%	1.48%
SONOMA	0.77%	0.84%	1.64%	0.88%
STANISLAUS	2.53%	1.83%	2.23%	1.42%
SUTTER	0.86%	0.18%	0.31%	0.21%
TEHAMA	1.16%	1.01%	0.22%	0.94%
TRINITY	0.22%	0.10%	0.04%	0.14%
TULARE	1.98%	2.17%	1.98%	1.98%
TUOLUMNE	0.02%	0.11%	0.14%	0.11%
VENTURA	0.84%	0.96%	1.24%	1.71%
YOLO	0.80%	1.25%	1.96%	1.15%
YUBA	0.05%	0.14%	0.23%	0.14%

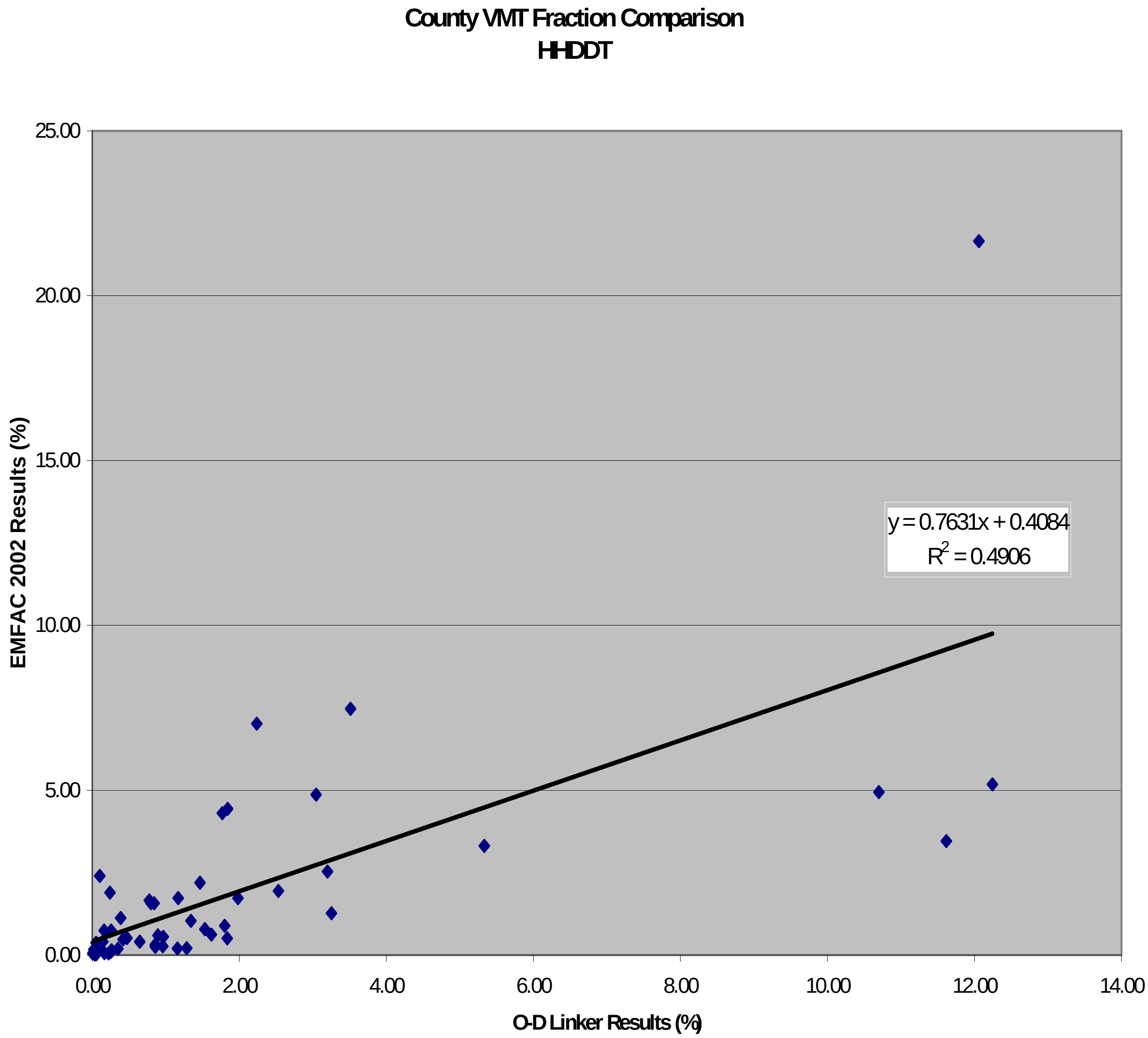
Graph A-1: Correlation of Network Routing with GPS base data.



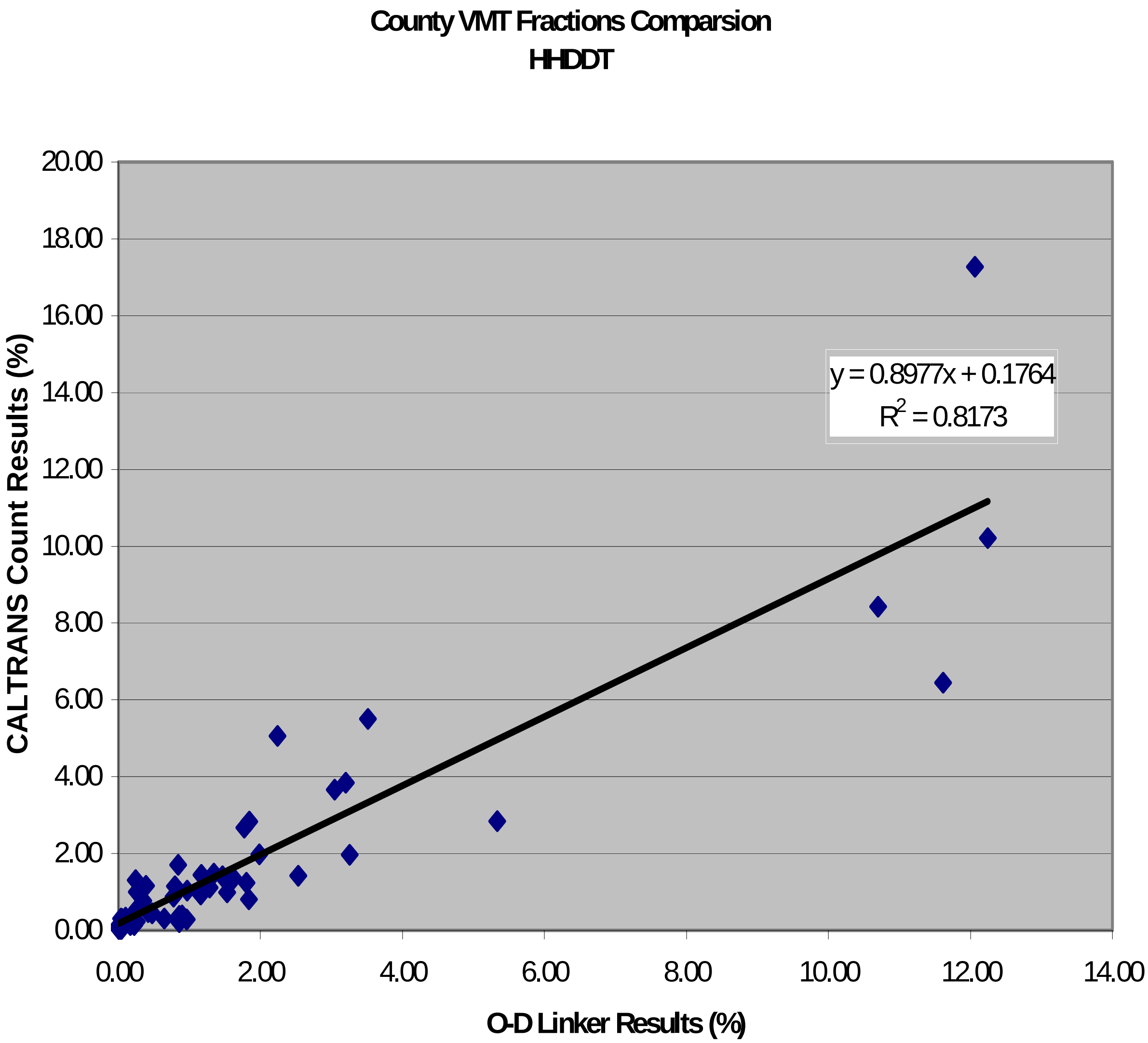
Graph A-2: Correlation of Network Routing with MVSTAFF



Graph A-3: Correlation of Networking Routing with EMFAC 2002



Graph A-4: Correlation of Network Routing with CALTRANS Count



Appendix B

Software Code Developed for Batch Processing

```
'myTable = av.GetActiveDoc
'myVTab  = myTable.GetVTab
'myField = myVTab.FindField("test2")

'Set Focus on Preset View
'
aView=av.GetProject.FindDoc("View1")
'
'Set Table to the File that has data
'
aVTab = av.GetProject.FindDoc( "hdtruck2_all_meters_B.dbf" ).GetVTab
'
'
' Get the fields to copy from aVTab

  xA = aVTab.FindField( "Ax_meters" )
  yA =  aVTab.FindField( "Ay_meters" )
  xB =   aVTab.FindField( "Bx_meters" )
  yB =    aVTab.FindField( "By_meters" )
  Projid = aVTab.FindField( "Id" )
  LatAx  =  aVTab.FindField( "Q42" )
  LongAy =   aVTab.FindField( "Q43" )
  LatBx  =    aVTab.FindField( "Q45" )
  LongBy  =     aVTab.FindField( "Q46" )
  RptDist =     aVTab.FindField( "Q38" )
'
'
' Find the Theme in the present view
'
aNetTheme =
av.GetProject.FindDoc("View1").FindTheme("St_Hwy_teale_albers.shp")
'
'
aNetFTab = aNetTheme.GetFTab
aNetDef = NetDef.Make(aNetFTab)
aNetwork = Network.Make(aNetDef)
'
'
idField = Field.Make("id",#FIELD_DECIMAL,8,0)
lenField=  Field.Make ("Length", #FIELD_DECIMAL,10,2)
ProjField =  Field.Make ("Projid", #FIELD_LONG,10,0)
LatAxField     =  Field.Make ("LatAx", #FIELD_decimal,10,5)
```

```
LongAyField     =  Field.Make ("LongAy", #FIELD_Decimal,10,5)
LatBxField      =  Field.Make ("LatBx", #FIELD_Decimal,10,5)
LongByField     =  Field.Make ("LongBy", #FIELD_Decimal,10,5)
RptDistField    =  Field.Make ("RptDist", #FIELD_Decimal,10,2)
Ax_mField    =  Field.Make ("Ax_Meters", #FIELD_decimal,14,5)
Ay_mField    =  Field.Make ("Ay_Meters", #FIELD_Decimal,14,5)
Bx_mField     =  Field.Make ("Bx_Meters", #FIELD_Decimal,14,5)
By_mField    =  Field.Make ("By_Meters", #FIELD_Decimal,14,5)

'
idField1 = Field.Make("id",#FIELD_DECIMAL,8,0)
lenField1=  Field.Make ("Length", #FIELD_DECIMAL,10,2)
ProjField1=  Field.Make ("Projid", #FIELD_LONG,10,0)
LatAxField1     =  Field.Make ("LatAx", #FIELD_decimal,10,5)
LongAyField1     =  Field.Make ("LongAy", #FIELD_Decimal,10,5)
LatBxField1      =  Field.Make ("LatBx", #FIELD_Decimal,10,5)
LongByField1     =  Field.Make ("LongBy", #FIELD_Decimal,10,5)
RptDistField1     =  Field.Make ("RptDist", #FIELD_Decimal,10,2)
Ax_mField1     =  Field.Make ("Ax_Meters", #FIELD_decimal,14,5)
Ay_mField1     =  Field.Make ("Ay_Meters", #FIELD_Decimal,14,5)
Bx_mField1      =  Field.Make ("Bx_Meters", #FIELD_Decimal,14,5)
By_mField1     =  Field.Make ("By_Meters", #FIELD_Decimal,14,5)
'
'
idField2= Field.Make("id",#FIELD_DECIMAL,8,0)
lenField2=  Field.Make ("Length", #FIELD_DECIMAL,10,2)
ProjField2=  Field.Make ("Projid", #FIELD_LONG,10,0)
LatAxField2    =  Field.Make ("LatAx", #FIELD_decimal,10,5)
LongAyField2    =  Field.Make ("LongAy", #FIELD_Decimal,10,5)
LatBxField2     =  Field.Make ("LatBx", #FIELD_Decimal,10,5)
LongByField2    =  Field.Make ("LongBy", #FIELD_Decimal,10,5)
RptDistField2    =  Field.Make ("RptDist", #FIELD_Decimal,10,2)
Ax_mField2    =  Field.Make ("Ax_Meters", #FIELD_decimal,14,5)
Ay_mField2    =  Field.Make ("Ay_Meters", #FIELD_Decimal,14,5)
Bx_mField2     =  Field.Make ("Bx_Meters", #FIELD_Decimal,14,5)
By_mField2    =  Field.Make ("By_Meters", #FIELD_Decimal,14,5)


'
'Create a file for output
'  1. Successful route
'   2. Route Not Found
'    3. Points not Located on Map
'
pointtable = Ftab.MakeNew("New".asfilename, PolyLine)
 pointtable1 = Ftab.MakeNew("New_Error".asfilename, PolyLine)
```

```
  pointtable2 = Ftab.MakeNew("PtNotLoc".asfilename, PolyLine)

'
idCount=1
'lonField = Field.Make ("Longitude",#FIELD_DECIMAL,10,0)
'latField = Field.Make ("Latitude",#FIELD_DECIMAL,10,0)
'
'Add fields to each file
'
'
pointtable.addFields({idField})
POINTTABLE.ADDFIELDS({LENFIELD})
pointtable.addFields({projfield})
pointtable.addFields({LatAxField})
pointtable.addFields({LongAyField})
pointtable.addFields({LatBxField})
pointtable.addFields({LongByField})
pointtable.addFields({RptDistField})
'
pointtable.addFields({Ax_mField})
pointtable.addFields({Ay_mField})
pointtable.addFields({Bx_mField})
pointtable.addFields({By_mField})

'
'
'
pointtable1.addFields({idField1})
POINTTABLE1.ADDFIELDS({LENFIELD1})
pointtable1.addFields({projfield1})
pointtable1.addFields({LatAxField1})
pointtable1.addFields({LongAyField1})
pointtable1.addFields({LatBxField1})
pointtable1.addFields({LongByField1})
pointtable1.addFields({RptDistField1})

pointtable1.addFields({Ax_mField1})
pointtable1.addFields({Ay_mField1})
pointtable1.addFields({Bx_mField1})
pointtable1.addFields({By_mField1})

'


pointtable2.addFields({idField2})
POINTTABLE2.ADDFIELDS({LENFIELD2})
pointtable2.addFields({projfield2})
```

```
pointtable2.addFields({LatAxField2})
pointtable2.addFields({LongAyField2})
pointtable2.addFields({LatBxField2})
pointtable2.addFields({LongByField2})
pointtable2.addFields({RptDistField2})
'
pointtable2.addFields({Ax_mField2})
pointtable2.addFields({Ay_mField2})
pointtable2.addFields({Bx_mField2})
pointtable2.addFields({By_mField2})
'
'
' Add shapefield to the Successful Route file
'  but not to the error file as there would be no shape.
'
shapefield = pointtable.FindField("Shape")
'
RecNum=0
for each record in aVTab
  RecNum=RecNum+1

'Get Projid
  Projidd = avtab.returnvalue(projid,record)
  LatAxd  =  aVTab.returnvalue(LatAx,record)
  LongAyd =   aVTab.returnvalue(LongAy,record)
  LatBxd  =    aVTab.returnvalue(LatBx,record)
  LongByd  =     aVTab.returnvalue(LongBy,record)
  RptDistd =     aVTab.returnvalue(RptDist,record)

'Get starting point
  XS = aVTab.ReturnValue(xA, record)
  XadS = XS
  YS =  avtab.returnvalue(yA,record)
  YadS = YS
'
'  Make a pointlist
'
  pointList = {}
'
  ps = point.make(xs,ys)
'
'Get ending point
  XE = aVTab.ReturnValue(xB, record)
  XbdE = XE
  YE =  avtab.returnvalue(yB,record)
  YbdE = YE
```

```
  pe = point.make(xe,ye)


'
  if ( (not (aNetwork.IsPointOnNetwork(ps))) or (not
(aNetwork.IsPointOnNetwork(pe))) )then
'
'
    newRecNum = pointtable2.addrecord
'   pointtable2.setvalue(shapefield,newRecNum, aPathShape)
    pointtable2.setvalue(idField2,newRecNum,idCount)
    pointtable2.setvalue(projfield2,newrecnum,projidd)
    pointtable2.setvalue(LatAxfield2,newrecnum,LatAxd)
    pointtable2.setvalue(LongAyfield2,newrecnum,LongAyd)
    pointtable2.setvalue(LatBxfield2,newrecnum,LatBxd)
    pointtable2.setvalue(LongByfield2,newrecnum,LongByd)
    pointtable2.setvalue(RptDistfield2,newrecnum,RptDistd)
    pointtable2.setvalue(Ax_mfield2,newrecnum,XS)
    pointtable2.setvalue(Ay_mfield2,newrecnum,YS)
    pointtable2.setvalue(Bx_mfield2,newrecnum,XE)
    pointtable2.setvalue(By_mfield2,newrecnum,YE)
      'p.SetName(aStopFTab.ReturnValueString(pointLabelField, rec))
'
'
'
   else
'
      pointList.Add(ps)
        pointList.Add(pe)
'
      findBestOrder  = True
      returnToOrigin = False

  ' calculate the path
  '
    pathCost = aNetwork.FindPath(pointList,findBestOrder,returnToOrigin)

  ' make sure the FindPath succeeded
  '
  if ((not (aNetwork.HasPathResult)) or (pathCost = 0)) then
    'msgBox.Info("Error","")
    'exit
 '
    'Create exception table above
    '
    'write table record to exception table for later lookup and resolution
```

```
    '
'
    newRecNum = pointtable1.addrecord
'    pointtable1.setvalue(shapefield,newRecNum, aPathShape)
    pointtable1.setvalue(idField1,newRecNum,idCount)
    pointtable1.setvalue(projfield1,newrecnum,projidd)
    pointtable1.setvalue(LatAxfield1,newrecnum,LatAxd)
    pointtable1.setvalue(LongAyfield1,newrecnum,LongAyd)
    pointtable1.setvalue(LatBxfield1,newrecnum,LatBxd)
    pointtable1.setvalue(LongByfield1,newrecnum,LongByd)
    pointtable1.setvalue(RptDistfield1,newrecnum,RptDistd)
    pointtable1.setvalue(Ax_mfield1,newrecnum,XadS)
    pointtable1.setvalue(Ay_mfield1,newrecnum,YadS)
    pointtable1.setvalue(Bx_mfield1,newrecnum,XbdE)
    pointtable1.setvalue(By_mfield1,newrecnum,YbdE)
'
  else

' display the cost
'
' create a shape for the path
'
  aPathShape = aNetwork.ReturnPathShape

' make a graphic shape
'
'  aGraphicShape = GraphicShape.Make(aPathShape)

' make a nice symbol
'
  'aSymbol = Symbol.Make(#SYMBOL_PEN)
'  aSymbol.SetSize(3)
'  aSymbol.SetColor(Color.GetBlue)
'  aGraphicShape.SetSymbol(aSymbol)
'
'' add the graphic to the view
''
'  aView.GetGraphics.Add(aGraphicShape)
'
' Add Shape to the New File

  newRecNum = pointtable.addrecord
  pointtable.setvalue(shapefield,newRecNum, aPathShape)
  pointtable.setvalue(idField,newRecNum,idCount)
  pointtable.setvalue(projfield,newrecnum,projidd)
  pointtable.setvalue(LatAxfield,newrecnum,LatAxd)
```

```
  pointtable.setvalue(LongAyfield,newrecnum,LongAyd)
  pointtable.setvalue(LatBxfield,newrecnum,LatBxd)
'
  pointtable.setvalue(LongByfield,newrecnum,LongByd)
'
  pointtable.setvalue(RptDistfield,newrecnum,RptDistd)
'
  'pointtable.setvalue(latField,newRecNum, (Y))
  'sngLen=sngLen.SetNumberFormat("dddddd.dd")
  sngLen=aPathShape.ReturnLength.SetFormat("dddddd.dd")
  POINTTABLE.SETVALUE(LENFIELD,NEWRECNUM,sngLen/1609.344)
'
  pointtable.setvalue(Ax_mfield,newrecnum,XadS)
  pointtable.setvalue(Ay_mfield,newrecnum,YadS)
  pointtable.setvalue(Bx_mfield,newrecnum,XbdE)
  pointtable.setvalue(By_mfield,newrecnum,YbdE)

'
  idCount=idCount + 1
'
'
'  if (record >=500 ) then
'    exit
'  end
end
end
end
pointTable.SetEditable(false)
theView = av.GetActiveDoc

' identify the data and create the new theme
'
'theSrcName = SrcName.Make( "C:\apela\new5.shp" )
'if (theSrcName = nil) then
'  msgbox.Error( "Invalid SrcName", "")
'  exit
'end
'
'theTheme = Theme.Make( theSrcName )
'
' make the theme visible and add it to a view
'
'theTheme.SetVisible( true )
'theView.AddTheme( theTheme )
'
msgbox.info ("Finished","")
```